SEMI-AUTOMATIC PLASTIC SPIRAL BINDING MACHINE

FIELD OF THE INVENTION

The invention relates to a semi-automatic plastic spiral binding machine which inserts the plastic spiral into aligned holes in a spiral bound book and cuts and inwardly bends the coil ends.

BACKGROUND OF THE INVENTION

While most of the prior art in the field of spiral binding apparatus relates to the use of metallic wire spirals, two patents specifically relate to the use of plastic spirals. The patent of Penner (2,638,609) describes a machine for binding books with special features for aligning the perforations of a sheaf of papers to be bound and to confine the travel of the plastic spiral binding material. The patent of Pfaffle (4,249,278) describes a machine for spiral binding which feeds plastic thread from a bulk spool, softens the thread, winds it on a mandrel to form a spiral, cools it to harden and then feeds the rigid spiral into a perforated sheet group.

U.S. Patent No. 4,378,822 of Morris describes a spiral binding machine with a drive component. However, the mandrel of Morris `822 is fixed, not laterally adjustable as in the present invention, and the mandrel of Morris `822 has a closed end, which requires pre-feeding of the spiral thereon.

OBJECTS OF THE INVENTION

It is an object of this invention to overcome the complexity of prior art machines that are designed to handle plastic spirals for binding.

It is yet another object of this invention to provide a spiral bound book which prevents ripping at the edge of the book by maximizing the gap from the edge of the book to the first spiral coil insertion hole of the book.

It further an object of the present invention to provide a spreading means for increasing the gap between adjacent coil segments, to be able to insert the coil into the first spiral insertion hole of the book.

It is yet another object of this invention to provide an advancement means for accurately transporting a plastic spiral coil to its proper position for insertion into the first spiral insertion hole of the book.

It is another object of this invention to be able to handle a wide variety of plastic spiral sizes with minimal custom tooling features to handle the different sizes.

It is another object of this invention to provide a semi-automatic machine of low cost and reliable operation.

SUMMARY OF THE INVENTION

In keeping with the objects of the present invention and others which may become apparent, the basic operational concept of the present invention is to use an adjustable speed drive to rotate a spiral coil for a spiral bound book at optimum speed for the diameter of a particular spiral as well as the thickness of the book being bound. This, along with a smooth mandrel with a spiral stabilizing spring, controls the proper feeding of the spiral without the necessity for expensive machined parts to confine the spiral to prevent its distortion.

The binding machine of the present invention spirally binds a sheaf of papers into a book. It clamps together the sheaf of papers making up the book, which book has a plurality of holes in a row adjacent to one edge of the book, to receive the leading edge of the spiral binding element. The machine includes a stationary base which is from one end of the book, and a block slidably mounted on the base, which has an arm extending outwardly.

The arm supports at its distal end thereof a cylindrically shaped mandrel, which is spaced from the slidable block and the bottom edge of the mandrel horizontally in a line corresponding with the row of holes in the book. The arm is attached at its distal end to the mandrel at the proximate end of the mandrel, which faces the row of holes and is spaced apart from the book. The arm is attached to the block at the proximate end, to adjust the distance between the mandrel and the block.

A feeding mechanism feeds a plastic, pre-formed, spiral binding element onto the mandrel, from the distal end thereof, which spiral binding element terminates at the proximate end of the mandrel. The leading edge of the binding element faces, and is spaced apart from, the book. The internal diameter of the spiral binding element is slightly in excess in size of the outer diameter of the mandrel.

A spring is mounted on the slidable block to engage and to adjustably bias the spiral binding element on the mandrel upwardly, against the mandrel, so that the upper portion of the binding element is spaced apart from the top of the mandrel.

A wheel, having an outer frictional surface, engages a top outer surface of the spiral binding element and a motor drives the wheel, to feed the spiral binding element into the row of holes in the book, for binding the book.

An adjusting mechanism adjusts the position of the block on the base, positioning the mandrel, to obtain proper alignment of the leading edge of the spiral binding element with the row of holes of the book.

To prevent ripping at the edge of the book after it is bound and used, the breach on the book's cover from the edge of the book to the first spiral coil insertion hole of the book is maximized. This is accomplished by a spreader which increases the breach between adjacent coil segments to align with the predetermined breach from the boundary of the book to the first hole, so that the plastic spiral coil can be accurately inserted

into the first spiral insertion hole of the book, and thereafter into the other holes for the book.

For example, while sizes of holes in the book may vary, the holes are typically 11/64 inch in diameter, and the measured space between the mid point of each hole to the next adjacent midpoint of the next adjacent hole is about ¼ inch. Consequently the space between adjacent holes is equal to 5/64 inch, which is measured as the distance of ¼ (or 16/64) inch from hole mid point to hole midpoint, taking into account and deducting the 11/64 diameter of each hole.

In the prior art the breach between the first hole and the leading boundary of the pages of the book has also been only about 5/64 inch, which is too small a breach to prevent damage by ripping of the cover at the boundary down to the first hole. In the present invention, the breach is increased to about 3/16 inch, which is more than double the length of the typical breach on the leading edge of a spiral bound book.

However, to increase the leading edge gap, the distance between adjacent coil segments of a plastic spiral coil must be increased from the typical 5/64 inch length to 3/16 inch.

This increase in distance is accomplished by a spreader mechanism which contacts and spreads apart the coils of the spiral as they advances from an alignment mandrel to the position where the spiral is enclosed into the leading hole of the book to be bound. The spreader moves apart the first adjacent coil segments from their hole engaging distance of 5/64 inch to the

increased distance of 3/16 inch.

The spreader device has a pair of leading edge spreaders located where the leading boundary edge of the book to be bound is held in place between a pair of comb jaw clamps. Two spreaders are used at the leading edge and a single spreader is used at the trailing edge of the book.

The leading spreader has a body with a slot therein for increasing or decreasing the position of the spreader with respect to the edge of the book to be bound with the plastic spiral.

This leading spreader is preferably a one piece metal unit with an arcuate convex edge being provided at the recess to engage and spread apart adjacent segments of the spiral coil as it advances over the breach between the leading boundary edge of the book and the first hole of the book, toward the first leading hole of the book to be bound.

This first spreader is mounted to a combed clamp jaw permanently attached to, or integral with, a top shelf of the spiral binding machine.

A second spreader, namely a side guide spreader, is mounted to an outer pivotal combed clamp jaw, which pivots into position for tightening the book between the two combed clamp jaws.

A trailing spreader guide is provided at the trailing end of the book to spread apart arcuate segments of the spiral coil as it exits the last edge hole at the trailing distal end of the book being bound. The trailing guide spreader is beveled with a

contoured end to engage the coils of the spiral as it engages the last trailing hole of the book.

The side guide spreader adjacent to the leading spreader is a single metal piece with an anvil-type blade extending in the direction of the leading spreader. The front of the blade is fixed to a curved pointed edge which is also rounded to engage the spiral without damage. A spiral guidance groove is located on the back edge of the blade of the spreader side guide to engage a single coil of the spiral.

The front leading spreaders combine to spread a single coil of the spiral as it goes into the first edge hole.

Guide notches of the combed clamp jaws are utilized at the path of plastic spiral as it moves through the holes in the book being bound. These notches also align with the holes of the book.

Likewise a conveyor moves the plastic spiral to the mandrel for its proper position for insertion into the first spiral insertion hole of the book. The conveyor includes upwardly extending side guide walls which attenuate on either side of the conveyor. A conveyor motor powers the conveyor belt about a pulley. In a preferred embodiment, the conveyor belt may be a pair of elastic cables placed parallel to one another, wherein the spiral touches the cables along the edges of the coil surfaces thereof.

The binding machine also optionally has a cutter for cutting. The spiral binding element is wound on the book at both ends of the book, and bends both ends of the binding element on

the book.

Preferably, the binding machine includes a sensor, such as an optical sensor, for signaling that the leading edge of the spiral binding element has been reached.

A positioning mechanism, such as a pneumatically driven mechanism, positions a rotatable wheel for contact with the spiral binding element. It includes a hydraulic shock absorber for mediating the speed of engagement of the wheel with the spiral binding element.

Furthermore, optionally the cutter includes a pair of separated cutting members which are spaced apart from each other, and a rotatable arm for engaging the two cutting members and for actuating the cutting and bending action when rotated in one direction. A further member moves the rotatable arm in a second direction.

A control panel is provided for sequencing the steps of binding the book and indicating visually when the cutting and bending of ends is completed, so that the binding action can be repeated for the next subsequent book to be spirally bound.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can best be understood in connection with the accompanying drawings, in which:

Figure 1 is a front view of the binding machine of the present invention;

Figure 2 is a side view of one embodiment for the binding machine;

Figure 2A is a side view of an alternate preferred embodiment of the binding machine;

Figure 2B is a close up perspective view of the coil stop portion of the binding machine as in Figure 2A;

Figure 2C is a close up perspective view of an L-shaped book stop to regulate pitch angle of the book spiral;

Figure 3 is an end view of spiral drive mechanism;

Figure 4 is a front view close-up of the mandrel;

Figure 4A is a front elevational view of a preferred embodiment for the mandrel holding spring member;

Figures 5A and 5B are front views of a cutter, wherein:

Figure 5A is a view in raised position;

Figure 5B is a view in cutting position;

Figure 6 is a top view of cut and bent spiral end;

Figure 7 is a pneumatic schematic diagram;

Figure 8 is one embodiment for an electrical schematic diagram;

Figure 9 is the preferred electrical schematic diagram;

Figure 10 is a front top detail of book hole pattern;

Figure 11 is an isometric view of coil spreader;

Figure 12 is an isometric detail showing relationship between coil spreader, book clamp, and mandrel;

Figure 13 is a top view detail showing both coil spreaders;

Figure 14 is a front elevational view of the binding machine showing an alternate embodiment with a spiral feeding conveyor;

Figure 15 is an isometric back view detail of the conveyor subsystem as in Figure 14;

Figure 15A is an end view detail of the conveyor thereof;

Figure 16 is an isometric view of a trailing spreader of a further alternate embodiment for a spreader sub-system;

Figure 17 is an isometric view of the top mounted part of the leading spreader used in conjunction with the alternate embodiment shown in Figure 16;

Figure 18 is an isometric view of the side mounted part of the leading spreader of the alternate embodiment of Figures 16 and 17;

Figure 19 is a top plan view of the three spreader parts of the alternate embodiment shown in Figures 16, 17 and 18, shown as mounted on the binding machine; and,

Figure 20 is a top plan view detail of the placement of the two front spreader parts shown in Figure 19, shown with a spiral coil.

DETAILED DESCRIPTION OF THE DRAWINGS

Figure 1 shows a front view of the semi-automatic plastic spiral binding machine 1. A frame 2 supports a lower shelf 3 and a top shelf 4 which is a mounting platform for most of the apparatus. A control panel 5 shows a spinner speed control 31, a main on/off switch 30 and four other switches which have enable/disable positions. These switches are used to isolate several machine subsystems during diagnostic testing or preventative maintenance. They are the gate switch 32, the spinner engage switch 33, the knife switch 34 and the sensor switch 35. Except for the spiral spinner which is driven by an electric motor 14, all of the other moving elements of the machine 1 are pneumatically driven. This is a cost-effective and reliable design feature.

Some of the machine elements may be more visible in the side view of figure 2. A main shaft 19 is carried in bearing blocks 22 and 21; it rotates only a about 30 degrees in operation and is driven by pneumatic cylinder 18 through piston rod 51 acting on offset arm 20 which is fastened to main shaft 19. Shaft 19 is used to actuate both cutters 23 and 24 through drive bars 27 attached to shaft collars 26. Each of the cutters 23 and 24 pivots on an arm 51 which rotates freely on shaft 19. This arm is spring biased through adjustable stop 52 to be at its uppermost position until urged downward by the action of bar 27.

Dual springs 29 resist the motion of bar 27 thereby moving the entire cutter 23 or 24 downward into engagement with the

spiral 38 end to be cut; this coincides with the stop adjustment of 52. At this point, further downward movement of the end of bar 27 moves arm 26 which actuates the cutter/bender element (not shown) within cutters 23 and 24. A sensor switch 108 (not shown in these views) detects that the cutting action has been accomplished. Cutter 23 is fixed laterally to coincide with the rightmost edge of book 12; cutter 24 has a lateral adjustment 25 which adjusts it to the left edge of book 12.

A book 12 to be bound is shown clamped by clamp element 13 attached to clamp shaft 9 which is retained in bearing blocks 36. The clamping action is supplied by pneumatic cylinder 11 acting on arm 10. Adjustable stop screw 40 adjusts the clamping to the thickness of book 12 and also actuates a "gate down" sensor switch 105 (not shown in these views). The book 12 is supported by adjustable book holder 17.

Book 12 has holes 39 which will accept plastic spiral wire 38 as it emerges from the mandrel 80 which is barely visible in figure 1 at the left end of spiral chute 8. The spiral wire 38 is spun by a dc gear motor 14 which drives a jackshaft through a timing belt and pulley arrangement 15. The final spinner drive is via belt 16. An optical detector 37 detects the end of the spiral wire 38 as it emerges from the left edge of book 12.

In the preferred embodiment shown in Figures 2A and 2B, half cylindrical stop member 201 extends longitudinally adjacent to spiral wire 38 to restrict lateral movement thereof. Moreover, in the preferred embodiment of Figure 2C, L-shaped angled book

stop 202 maintains pitch angle of the perforation holes 39 which accept spiral wire 38.

Figure 3 is a simplified end view of the engagement and drive system of the spiral spinner.

Figure 4 is a front view of the mandrel 70 fixture with the spiral shown in crossection for clarity. The mandrel 70 has a bullet shaped nose 80 over with spiral wire 38 is fed from chute 8. An upright 79 which fits between the spiral wire 38 coils attaches mandrel 70 to block 76 by bolt 78. Block 76 is slidably attached to base 75 through dovetail slide 77 and a vernier adjustable in a lateral direction via vernier screw 82. A stabilizing leaf spring 81 gently presses the coils of spiral wire 38 against mandrel 70. The force can be adjusted by laterally sliding spring 81 over pin 82 and then tightening the retaining screws.

Figure 3 shows an end view of spiral wire 38 around mandrel 70 with a wheel, such as fabric covered foam rubber wheel 69, pressing against it to rotate it. Alternatively, a wheel with a soft rubber tire can be used. The wheel 69 is urged against the spiral wire 38 or withdrawn from it by pneumatic cylinder 60 with extend port 61 and retract port 62. The speed of engagement is mediated by hydraulic shock absorber or snubber 68 which is always in contact with arm 66 which pivots concentrically on shaft 64. Pulley 65 and belt 16 drive wheel 69 by an upper pulley (not shown).

In the preferred embodiment shown in Figure 4A, coil stop

member 181 includes projections 182, 183 to engage between adjacent coils of spiral wire 38, to hold spiral wire 38 in place. Upward tension against coil stop member 181 is provided by coil spring 184.

Figure 5 shows the geometric relation of cutter 24 in its raised position at "A" and in its cutting position at "B" with cut spiral end 86 falling away. The position of optical sensor 37 relates to the emerging spiral wire 38 and the left edge of book 12. Being mounted via an adjustable armored cable it can easily accommodate a variety of book 12 widths.

Figure 6 is a top view detail showing the cut bent end of the spiral wire 38 after the cutting process. The cutters 23 and 24 are similar in operation to those commonly used for cutting and bending wire spirals.

The setup of the machine includes the following steps for customizing the subassemblies to match the particular book 12 size and spiral wire 38. The properly sized mandrel 70 is fitted and adjusted laterally by vernier screw 82 to guide spiral 38 to engage the book 12 perforations 39. The proper spinner speed is selected via control 31. The optical sensor is precisely positioned at the left edge of book 12. This may include one or more test runs.

The operation of the machine in the preferred embodiment is as follows:

Book 12 is placed in previously adjusted holder 17;

Right pedal 7 is pressed once to close clamp 13;

Spiral 38 is loaded in chute 8 and its end is positioned around mandrel 70;

Right pedal 7 is pressed one more time to initiate the automatic sequence. After spiral machine stops its sequence, left pedal 6 is pressed once to open clamp 13; and,

Bound book 12 with spiral wire 38 therein is removed.

Although many design variations are possible without deviating from the spirit of the invention, the preferred embodiment is electropneumatic in design with no custom electronics or computer control. In this manner, it can be easily maintained by an electromechanical technician with no electronic or computer training. The preferred embodiment uses AC solenoid valves and relays. In alternate embodiments, low voltage DC solenoid valves, solid-state relays and/or microprocessor controls could be used to perform equivalent control tasks.

Figure 7 shows a pneumatic system schematic. Shop air at 70 to 100 psig is supplied by a hose at A and coupled to the machine via "quick disconnect" 90. A filter/dryer 91 filters contaminants from the compressed air supply and removes moisture.

Next a lubricator 92 adds a small amount of oil to extend the life of the cylinders and valves. A manifold 99 distributes the filtered and lubricated air to three individual pressure regulators with integral indicators 93, 94 and 95. In this manner the pressure to the individual cylinders can be adjusted to select the optimum force for the particular task. Regulator

93 feeds solenoid valve 96 which controls cutter cylinder 18. Similarly, regulator 94 feeds solenoid valve 97 which controls spinner engagement cylinder 60. Finally, regulator 95 feeds solenoid valve 98 which controls the gate actuator cylinder 11. All solenoid valves are of the two port reversing two position type which extend or retract the two port double acting cylinders. The unenergized position of solenoid valves 96 and 97 keep their respective cylinders retracted by supplying pressure to the retract port while venting the extend port. Solenoid valve 98 keeps cylinder 11 extended in its unenergized position to keep the gate open by supplying pressure to the extend port while venting the retract port.

Figure 8 is an electrical schematic of one embodiment. Right pedal 7 has two switches, a single-pole double-throw switch 102 and a single-pole single-throw (SPST) switch 103. The left pedal 6 has an SPST switch 104. Plug 100 supplies 115 VAC through main switch 101. Motor controller 31 drives spinner motor 14 continuously as long as 101 is on. By pressing the right pedal 7 once, relay 106 is energized closing its normally open contacts; it is latched on via feedback through normally closed switch 104. Switches 32, 33, 34 & 35 are simply enable/disable switches used in maintenance as described before. Solenoid valve 98 is energized retracting cylinder 11 and closing the clamp 13. Normally open switch 105, which senses that clamp 13 is closed, is now closed. This latches sequence relay 107 on. When right pedal 7 is again briefly energized, an automatic

sequence is started. Switch 103 now energizes relay 109 through relay 107. This powers the sensor controller 110 which has a latched relay at its output 111. The normally closed (NC) contacts of 111 energize solenoid valve 97, which solenoid valve 97 drives spiral wire 38 through book perforations 39. When sensor 37 detects the end of the spiral wire 38 emerging from the left end of book 12, switch 111 is switched to open the NC contacts stopping spiral feeding and closes the normally open contacts which energize solenoid valve 96 thereby operating the cutter mechanism through cylinder 18. When the cutters have completed their cycle, normally closed sensor switch 108 is opened thereby resetting relays 107 and 109 completing the automatic cycle and resetting the appropriate pneumatic cylinders as well as sensor controller 110. Now, when left pedal 6 is briefly pressed, relay 106 is reset by opening switch 104 thereby de-energizing solenoid valve 98 which extends cylinder 11 thereby opening clamp 13 so that bound book 12 can be removed from the machine 1.

Figure 9 is an electrical schematic for the preferred embodiment. To start the machine 1, one turns on master power switch A1 at circuit line 1. 110 volts AC is supplied to the machine 1 from master power switch A1, and fuse F1 at circuit line 2. If the speed control for the spinner is turned clockwise, the spinner begins to turn.

To make a book, one first inserts a book onto the bottom supports of the clamp 13, shown in Figure 1. One presses and

holds the clamp foot pedal switch SW1 at circuit line 3, thereby activating and closing clamp 13. Through normally open contact of clamp foot pedal switch SW1, normally closed contact of relay RY2, and normally open contact of disable switch SW4, power is provided to clamp solenold SOL1 at circuit line 3.

Thereafter, the clamp 13 closes. The closing of clamp 13 triggers microswitch SW3 at circuit line 6. Through normally open contact of microswitch SW3, clamp hold relay RY4 is powered at circuit line 5. Normally open contact of clamp hold relay RY4 1-3 closes at circuit line 4. Through microswitch SW3, normally open contact of clamp hold relay RY4, normally closed contact of knife cutter duration timer T2, and normally open contact of disable switch SW4, power is provided to clamp solenold SOL1. The clamp 13 is then held closed.

Through normally open contact of microswitch SW3, normally closed contact of wire sensor SN1 at circuit line 7, and the normally closed contact of knife cutter foot pedal switch SW2, power is provided to spinner solenold SOL3. The spinner closes on the spiral wire and begins to feed the spiral wire.

For automatic operation, the spiral wire reaches wire sensor SN1. Normally closed contacts of wire sensor SN1, at circuit line 7, shift to circuit line 8, providing power through microswitch SW3, wire sensor SN1, disable switch SW8, and normally open contact of disable switch SW7 at circuit line 9 to knife solenold SOL4. The knives cutters 23, 24 come down. In addition, power is provided to knife cutter hold relay RY1 at

circuit line 10 and knife cutter duration timer T2 at circuit line 11. Through normally open contact gate closed microswitch SW3 at circuit line 6, and normally opened contact of knife cutter hold relay RY1 at circuit line 11, knife hold relay RY1 and knife duration timer T2 are held on.

For manual operation, the knife cutter foot pedal switch SW2 is pressed. Normally closed contacts of knife cutter foot pedal switch SW2, at circuit line 7 shift to normally open at circuit line 8, providing power through microswitch SW3, wire sensor SN1, knife cutter foot pedal switch SW2, and normally open contact of disable switch SW7 at circuit line 9, to knife cutter solenold SOL4. The knife cutters 23, 24 then come down. In addition, power is provided to knife cutter hold relay RY1 at circuit line 10 and knife cutter duration timer T2 at circuit line 11. Through normally open contact microswitch SW3 at circuit line 6, and normally open contact of knife cutter hold relay RY1 at circuit line 11, knife cutter hold relay RY1 and knife cutter duration timer T2 are held on.

After the delay time set at knife cutter duration timer T2, the timer T2 operates. The opening of the normally closed contact of knife cutter duration timer T2 at circuit line 3 removes power from clamp solenold SOL1. The fingers retract and clamp 13 opens. Microswitch SW3 is released. Spiral machine 1 is now ready for the next book.

In an alternate embodiment, two features have been added to improve the reliability of the automatic feeding of the plastic

binding spiral by the machine of this invention.

When using plastic coil spiral binding, the holes in the book pages and covers must have a larger diameter than those used for metal wire spiral binding to accommodate the plastic coil material which has a larger crossection. Figure 10 shows a detail of these holes 39 on a book 12. The bridge distance B between holes 39 is fixed and matches the pitch of the binding coil to be used. However, it is noted that the distances E to the edge of the book from the holes 39 at either end are larger than the bridge distance B to resist breakout. When starting the feeding operation by hand, it was an easy matter to spread the first coil of spiral 38 to properly engage the first hold 39 in book 12. Similarly, at the distal end, the spiral was stopped short or spread by hand to prevent the spiral 38 end from hitting the end of the book since the edge is farther away than the normal spiral 38 pitch.

To improve the reliability of the automatic feeding of spiral 38 in book 12 at the proximal and distal ends, this alternate embodiment includes two spreaders 200 as shown in Figure 11. These are two-part metal weldments with blade 203 welded to base 201 at an oblique angle A. A mounting slot 202 permits accurate positional adjustment to match the book 12 end and the spiral 38. The front of blade 203 is ground to an edge at corner 204 which is also rounded to engage spiral 38 without damage. The contour 205 spreads a single coil of the spiral as it enters into the first edge hole 39 or as it departs the last

edge hole 39 at the distal end of book 12. This action simulates the action of an operator performing the same operation manually.

Figure 12 is a detail showing the positional relationship of modified book clamp 210, mandrel 70, book 12, and proximal spreader 200. A top view detail in Figure 13 clearly shows the position of the two spreaders 200 in position to spread a coil of spiral 38 to guide it past the book 12 edges at either side.

Another feature shown in Figures 12 and 13 are the guide notches used along the plastic spiral path 38 as it progresses through holes 39 in book 12. The edge of clamp 210 which lies against book 12 has deep notches 211 which line up with holes 39. The bearing surface on the other side of the book (which is part of the stationary top of the binding machine) also has notches 215 which are slightly offset from notches 211 (top view) to position and accurately guide spiral 38 into holes 39 of book 12.

Although not absolutely necessary, these notches 211 and 215 help to prevent occasional jamming of spiral 38 especially if the pitch of the spiral is slightly distorted.

Furthermore, as shown in Figures 14, 15 and 15A, an advancement means, such as a conveyor 300, accurately transports the plastic spiral coil 38 to the mandrel 70 for its proper position for insertion into the first spiral insertion hole 39 of the book 12.

Figures 15 and 15A show details of the conveyor subsystem 300. Plate 307 attaches conveyor motor 301 (a stepper or gear motor) to the frame of the binding machine. Timing belt 302

powers conveyor drive pulley 303. Spiral 38 is supported and transported by the conveyor belt consisting of a pair of parallel elastic cables 306 which cradle spiral 38. Straight upwardly extending wall 304 and sloping upwardly extending wall 305 facilitate loading of spiral 38 lengths onto conveyor belt members 306.

Similar to the aforementioned spreader embodiment shown in Figures 12 and 13, in order to better provide a spiral bound book which prevents ripping at the edge of the book, the gap of the book's cover from the edge of the book to the first spiral coil insertion hole of the book is maximized by an alternate embodiment for a spreader system.

For example, as shown in Figures 16, 17, 18, 19 and 20, this is accomplished by the alternate spreader system which also increases the gap between adjacent coil segments to match the preferred gap from the edge of the book to the first hole, so that the plastic spiral coil can be accurately inserted into the first spiral insertion hole of the book, and thereafter into the remaining holes 39 for the book 12.

For example, while sizes of holes 39 in the book 12 may vary, the holes 39 are typically 11/64 inch in diameter, and the space between the mid point of each hole 39 to the next adjacent midpoint of the next adjacent hole 39 is about ¼ inch. Therefore the distance between adjacent holes 39 is equal to 5/64 inch, that being the distance of ¼ (or 16/64) inch from hole mid point to hole midpoint, minus the 11/64 width of each hole 39.

Normally, in the past the gap between the first hole 39 and the leading edge of the pages of the book 12 has also been only about 5/64 inch, which is too small a gap to prevent ripping of the cover of the book 12 at that point.

It therefore beneficial to increase the gap to about 3/16 inch, which is more than twice the size of the typical gap on the leading edge of a conventional spiral bound book.

However to increase the leading edge gap, the distance between adjacent coil segments of a plastic spiral coil 38 must be increased from the typical 5/64 inch length to 3/16 inch.

This distance is provided by a spreader mechanism which engages the coil as it advances from an alignment mandrel 70 to the position where it is inserted into the leading hole 39 of the book 12 to be bound. The leading spreader pushes apart the first adjacent coil segments from their hole engaging distance of 5/64 inch to the increased distance of 3/16 inch.

In this alternate spreader system, as shown in Figures 17, 19 and 20, one of the leading edge spreader parts 400 is mounted to the top surface of the rear fixed comb clamp member 450 with screw 401 in slotted adjustment hole 402. This adjustment is for increasing or decreasing the position of the spreader (see gap 415 in Figure 19) with respect to the edge of the book 12 to be closed with the spiral coil 38. A coil engaging guide slot 403 with arcuate convex edge 420 is at the distal end of an extension arm of spreader part 400.

The side front spreader part 404 is shown in Figures 18, 19

and 20. It is mounted to the side of the movable comb clamp jaw 210 with screw 405 in slotted adjustment hole 431. Further features include rounded tip 430, threaded set screw hole 432 and spiral guidance groove 433 on the back edge. The slotted adjustment allows for alignment to match the end of book 12 and spiral 38. As shown in figure 20, groove 433 engages a single coil of spiral 38, and set screw 406 adjusts the gap with the edge of jaw 210 so as to accommodate a variety of crossectional diameters of different types of spiral 38.

As shown in Figures 16 and 19, a trailing spreader guide 410 is provided at the trailing end of the book 12 to spread apart arcuate segments of the spiral coil 38 as it departs the last edge hole 39 at the trailing distal end of book 12. Trailing guide spreader 410 includes mounting screw 411 and slot 412 for positional adjustment of spreader 410 and beveled extension 413 having contoured end 425 to engage the spiral coils of spiral coil 38 as it engages the last trailing hole 39 of book 12.

The spreaders 400 and 404 act in concert to spread a single coil of the spiral coil 38 as it enters into the first edge hole 39. Spreaders 400 and 404 are positioned a distance 415 extending therefrom to the trailing end of mandrel 70 guiding spiral coil 38 toward book 12.

Figure 19 is a top plan detail view showing the positional relationship of modified book clamp 210, mandrel 70, book 12, and spreaders 400, 404 and 410 in position to spread a coil of spiral 38 to guide it past the book 12 edges at either side.

As similar to Figures 12 and 13 with respect to the embodiment using spreader 200, Figure 19 also shows the guide notches 211 of combed clamp jaws 210 and 450 used along the path of plastic spiral 38 as it progresses through holes 39 in book 12. Notches 211 also line up with holes 39. The bearing surface on the other side of the book forming the fixed comb clamp jaw 450 (which is part of the stationary top shelf 4 of the binding machine 1) also has notches 215 which are slightly offset from notches 211 (top view) to position and accurately guide spiral 38 into holes 39 of book 12. Notches 211 and 215 prevent occasional jamming of spiral 38 as it is transported through holes 39 of book 12.

It is also known that other modifications may be made to the present invention, without departing from the score of the invention, as noted in the appended claims.